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ARTHUR G. STUBBS.

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ILLUSTRATED INDEX OF BRITISH FRESHWATER SHELLS.

ARTHUR G. STUBBS.

CONTAINING LIFE-LIKE AND AUTHENTIC FIGURES OF ALL THE BRITISH SPECIES OF FRESHWATER SHELLS, WITH DESCRIPTIONS OF THE CHIEF CHARACTERISTICS, COLOURING, HABITAT, AND RELATIVE SCARCITY OR ABUNDANCE OF EACH SPECIES, AND AN ENUMERATION AND DESCRIPTION OF THEIR VARIETIES.

TAYLOR BROTHERS,
SOVEREIGN STREET, LEEDS.

1907.

INTRODUCTION.

THE author hopes that this index may prove a real help to the student of Conchology in identifying the British freshwater shells.

His idea is to present, at a moderate price, a plate of figures, carefully drawn from nature, that will expose the whole group at once, and thus allow a shell to be readily compared with the illustrations.

By means of a three-fold plate this has been accomplished, and by folding either of the side plates over the middle one the remaining exposed plate has the 'Key' to it opposite. The 'Key' to the middle plate is easily referred to by raising the left-hand plate.

The drawings are, for the most part, of natural size, but where the smaller species have been enlarged, a 'size-line' has been added.

In the descriptions of the plates, a colour-column is given, but it should be noted that it refers to the ground-colour of the cleaned shell, and not to the accidental covering of mud, of various hues, found on many shells. Moreover, as even the ground-colour varies in shells of the same species from different localities, too much reliance must not be placed on that alone.

In the adjoining column some of the main features that distinguish the species from others, somewhat similar, are pointed out.

With regard to 'habitat,' a great many of the species *may* be found wherever there is water, but they undoubtedly show a preference for still or running, shallow or deep, as the case may be. The usual 'habitat' is therefore given.

In the 'Frequency' column it may be as well to explain that 'local' means the species is confined to certain limited areas, though it may be abundant where it does occur. 'Frequent' means that the species is not common, but may turn up anywhere, and is pretty well distributed over the country.

With the exception of some of the chief forms of the variable *Limnæa peregra*, varieties have not been figured, but a descriptive list of them, together with monstrosities, will be found at the end of the book. They have been taken for the most part from Mr. L. E. Adams' "Manual of British Land and Freshwater Shells," to which delightful little book the reader is referred for hints on collecting, cleaning, mounting, and arranging in cabinets these most interesting objects of natural history.

PLATE II.—(Univalves).

Fig.	*Species & Authority*	*Colouring.*	*Chief Characteristics.*	*Habitat*	*Frequency*
17	Amphipeplea glutinosa (Brug.).	Pale horn colour	Extreme thinness, glossiness, mantle covers young shells	Lakes and ponds	Local
18	Limnæa involuta (Thompson)	Pale amber ...	Intorted spire. Only one habitat known	Lake on Cromaglaun Mountain near Killarney	Very rare
19	— truncatula (Müller)	Greyish horn color	Small size, turreted spire	Shallow water, on mud	Common
20	— glabra (Müller)	Ditto	Long tapering spire, glossiness	Ditches and ponds	Local
21	Physa fontinalis (Linné)	Horn colour ...	Sinistral, short blunt spire	Streams, canals, etc.	Common
22	Aplexa hypnorum (Linné)	Dark reddish horn colour	Sinistral, spindle shape	Ditches, streams, etc.	Local
23	Physa heterostropha (Say)	Reddish horn colour	Globoseness, sinistral (introduced)	Canals and reservoirs	Rare
24	— acuta (Drap.).	Pale horn colour	Pointed spire, sinistral (introduced)	Water tanks, Kew, etc.	Rare
25	Ancylus fluviatilis (Müller)	Yellowish grey	Limpet shape	Running water on stones	Common
26	Velletia lacustris (Linné)	Greyish horn colour	Long shape, twisted apex	Ditches, marshes, on water plants	Frequent
27	Neritina fluviatilis (Linné)	Mottled, often banded	Solidity, orange colored hinged operculum	Running or still water, on stones	Frequent
28	Paludestrina similis (Draparnaud)	Horn colour ..	Operculum. Short spire, swollen whorls	Thames marshes near Woolwich	Very rare
29	— ventrosa (Montagu)	Pale horn colour	Operculum. Long tapering spire	Brackish marshes	Local
30	— taylori (Smith)	Yellowish horn colour	Operculum. Blunt spire, rounded whorls	Canals and marshy lands	Rare
31	— jenkinsi (Smith)	Pale horn colour	Operculum. Tapering spire, often keeled	Ditches, streams, etc.	Frequent
32	— stagnalis(Baster)	Yellowish or reddish	Operculum. Cone shape, solidity	Brackish marshes close to sea	Common
33	Valvata cristata (Müller)	Pale horn colour	Operculum. Planorbis shape	Ditches, canals, etc.	Frequent
34	— piscinalis (Müller)	Brownish yellow	Operculum. Circular mouth, rounded whorls	Ditto	Common
35	Bithynia tentaculata (Linné)	Horn colour, often golden	Operculum. Glossiness, transparency	Ditches, rivers, canals, etc.	Common
36	— leachii (Shepp.)	Horn colour ...	Operculum. Deep suture, roundish mouth, size	Ditches, canals, etc.	Local
37	Vivipara vivipara (Linné)	Pale green with dark bands	Operculum. Blunt apex, no umbilicus	Canals, lakes, etc.	Common
38	— contecta (Millet)	Dark green with dark bands	Operculum. Sharp apex, deep suture, umbilicus	Canals, deep ditches, etc.	Frequent
39	Succinea putris (Linné)	Amber colour ...	Large body whorl, short spire, thinness	Amphibious, on water plants	Common
40	— oblonga (Drap.)	Greenish or yellowish	Small size, deep suture, long spire	Marshes, near sea coast	Rare
41	— elegans (Risso)	Deep amber colour	Narrow mouth, slender shape	Amphibious, on water plants	Common

PLATE III.—(Bivalves).

Fig.	*Species & Authority*	*Colouring*	*Chief Characteristics*	*Habitat*	*Frequency*
42	**Pisidium fontinale** (Draparnaud)	Grey	Prominent beaks, triangular shape	Ditches, ponds, etc.	Common
43	— **amnicum** (Müll.)	Greyish or yellowish	Large size, ridges, triangular shape	Ditto	Frequent
44	— **milium** (Held)	Grey	Prominent beaks, oblong shape	Ditto	Frequent
45	— **pusillum** (Gmel.)	Greyish or yellowish	Beaks nearly central, oval shape	Ditto	Common
46	— **nitidum** (Jenyns)	Grey	Glossiness, beaks central, round shape	Ditto	Local
47	**Sphærium corneum** (Linné)	Yellowish horn-colour	Globular form, oval shape	Ditto	Common
48	— **lacustre** (Mull.)	Grey	Capped beaks, sharp edges, squarish shape	Ditto	Frequent
49	— **rivicola** (Leach)	Reddish or olive-brown	Large size, colour	Canals and slow rivers	Frequent
50	— **pallidum** (Gray)	Greyish or yellowish	Oblong shape, sharp shoulders	Canals and ponds	Local
51	**Unio pictorum** (Linné)	Yellowish green	Narrow oblong shape	Canals, lakes, etc.	Common
52	— **tumidus** (Philippsson)	Dark brown ...	Oval shape, weight, and solidity	Ditto	Common
53	— **margaritifer** (Linné)	Dull black ...	Colour, eroded beaks	Rivers	Local
54	**Anodonta cygnea** (Linné)	Yellowish green or brown	Large size, parallel upper and lower margins	Canals, lakes, etc.	Common
55	— **anatina** (Linné)	Ditto	Raised hinge-line forming angle with lower margin	Ditto	Common
56	**Dreissensia polymorpha** (Pallas)	Yellowish, zig-zag markings	Boat shape, marking, byssus attachment	Canals, rivers, lakes	Common

PLATE I.

FIG. 1.

FIG. 2.

FIG. 3.

FIG. 4.

FIG. 5.

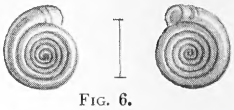


FIG. 6.

FIG. 7.

FIG. 8.

FIG. 9.

FIG. 10.

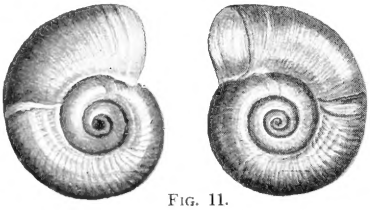


FIG. 11.

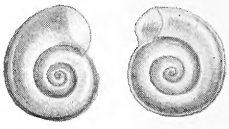


FIG. 12.

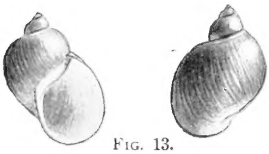


FIG. 13.

FIG. 13 *a*.

FIG. 13 *b*.

FIG. 13 *c*.

FIG. 13 *d*.

FIG. 13 *e*.

FIG. 13 *f*.

FIG. 13 *g*.

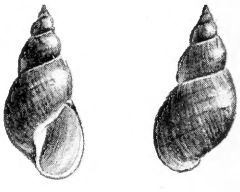
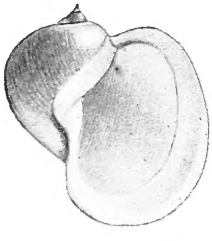


FIG. 14.



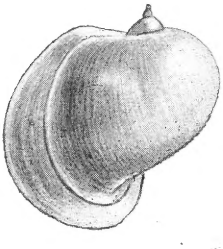


FIG. 15.

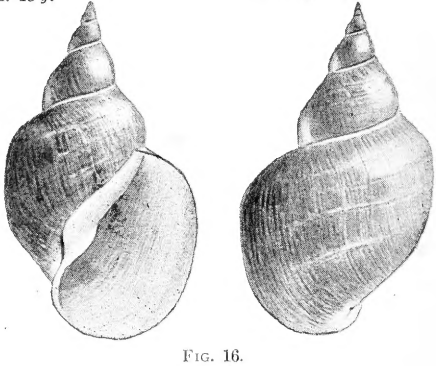


FIG. 16.

PLATE III.

FIG.		
42	Pisidium fontinale v. henslowana (Shepp.)	With ridge near the beaks.
—	— — var. pulchella (Jenyns)	Glossy, strongly grooved.
—	— — var. cinerea (Alder)	Larger and flatter.
—	— — var. pallida (Gassies)	More ventricose, with rays from beaks to margin
43	— amnicum var. læviuscula (Moq.)	Larger, fainter striæ.
—	— — var. flavescens (Moq.)	Pale yellow all over.
44	— milium var. alpestris (Clessin)	Very globose, strongly striated.
45	— pusillum var. obtusalis (Lamarck)	Smaller, more tumid.
—	— — var. grandis (Adams)	Much larger, 5 mm. × 6 mm.
46	— nitidum var. splendens (Moq.)	Larger, lemon coloured.
—	— — var. globosa (Adams)	Sphæroidal.
47	Sphærium corneum var. pisidioides (Gray)	Triangular, striæ coarser.
—	— — var. scaldiana (Normand)	Ovate, paler than type.
—	— — var. nucleus (Studer)	Smaller, nearly spherical.
—	— — var. flavescens (Macgill)	Pale yellow.
48	— lacustre var. ryckholti (Normand)	Small, beaks prominent, shoulders rounded.
—	— — var. rotunda (Jeffreys)	Rounder and flatter.
—	— — var. brochoniana (Bourg.)	Larger and flatter.
—	— — var. ovalis (Férussac)	Somewhat oval, with indistinct caliculation.
49	— rivicola var. flavescens (Moq.)	Yellow.
51	Unio pictorum var. curvirostris (Norm.)	Smaller, shorter, flatter.
—	— — var. latior (Jeffreys)	Broader, shorter, yellow-brown.
—	— — var. compressa (Jeffreys)	Very broad and flat.
—	— — var. radiata (Moq.)	With greenish rays.
—	— — var. platyrinchoidea (Dup.)	With posterior margin produced.
52	— tumidus var. mülleri (Rossm.)	More oval.
—	— — var. ovalis (Mont.)	Wedge-shaped.
—	— — var. ponderosa (Pascal)	Larger and very solid.
—	— — var. radiata (Colb.)	With greenish or yellowish rays.
53	— margaritifer var. sinuata (Lam.)	Broader, lower margin incurved.
—	— — var. roissyi (Mich.)	Longer, lower margin rounded outwards.
54	Anodonta cygnea var. arenaria (Schröter)	Broader, upper and lower margins parallel.
—	— — var. rostrata (Rossm.)	Ovate, crested upper margin.
—	— — var. stagnalis (Sowerby)	Thin, inflated, anterior end rounded, olive-green
—	— — var. incrassata (Shepp.)	More swollen and solid.
—	— — var. radiata (Müller)	Streaked yellowish-green.
—	— — var. pallida (Jeffreys)	Wedge-shaped, light yellow.
55	— anatina var. ventricosa (C. Pfr.)	Larger, more solid.
—	— — var. complanata (Rossm.)	Oval, compressed, beaks close to the anterior margin.
—	— — var. radiata (Jeffreys)	With green and yellow rays.
56	Dreissensia polymorpha v. angusta (Colb.)	Narrower.
—	— — var. dilatata (Colb.)	Broad and flat, beaks protruding beyond hinge

PLATE I. *(continued).*

14	Limnæa palustris var. corva (Gmelin)	Larger, more tumid, dark purple.
—	— — var. obesa (Taylor)	Very tumid.
—	— — var. elongata (Moq.)	Spire more produced.
—	— — var. conica (Jeffreys)	Conical, suture deep, with an umbilical cleft.
—	— — var. minor (Taylor)	Smaller, 8 mm. × 4½ mm.
—	— — var. tincta (Jeffreys)	Shorter and broader, mouth purplish.
—	— — var. lacunosa (Zgl.)	With rows of malleations.
—	— — var. fasciata (Nelson)	With three spiral dark bands on body whorl.
—	— — var. roseolabiata (Jeff.)	With rose-coloured rib.
—	— — var. albida (Nelson)	White.
—	— — m. decollatum (Jeffreys)	Spire truncate.
15	— auricularia var. acuta (Jeffreys)	Smaller, oblong, mouth narrower.
—	— — var. ampla (Hartmann)	Aperture extending beyond apex.
—	— — var. reflexa (Nelson)	Outer lip much reflected.
—	— — var. magna (Colb.)	Larger, mouth narrower.
—	— — var. albida (Jeffreys)	White.
16	— stagnalis var. fragilis (Linn)	Smaller, thinner, more slender.
—	— — var. bottnica (Clessin)	Smaller, dark, suture deep.
—	— — var. lacustris (Studer)	Spire short, body whorl large.
—	— — var. labiata Jeffreys	Outer lip enlarged.
—	— — var. variegata (Hazay)	With variegated white markings.
—	— — var. albida (Jeffreys)	White.
—	— — m. sinistrorsum (Jeffreys)	Sinistral.
	— — scalariforme	Whorls disconnected.

PLATE II.

FIG.		
17	Amphipeplea glutinosa v. mucronata (Jeff.)	Spire more produced.
—	— — var. albida (Williams)	White.
19	Limnæa truncatula var. ventricosa (Moq.)	Tumid, spire short.
—	— — var. elegans (Jeffreys)	Larger, tapering spire.
—	— — var. microstoma (Drouet)	Mouth contracted.
—	— — var. albida (Nelson)	White.
—	— — m. scalariforme (Jeffreys)	Whorls disunited.
20	— glabra var. elongata (Jeffreys)	Spire produced.
21	Physa fontinalis var. inflata (Moq.)	Much larger, more ventricose.
—	— — var. curta (Jeffreys)	Spire very short.
—	— — var. oblonga (Jeffreys)	Spire produced.
—	— — var. albina (Jeffreys)	White.
22	Aplexa hypnorum var. rubra (Tryon)	Dark reddish.
25	Ancylus fluviatilis var. capuloides (Jan.)	Larger, apex near the centre.
—	— — var. gibbosa (Bourguignat)	Small, with apex overhanging posterior margin
—	— — var. stricta (Morel)	Much elevated, sides compressed.
—	— — var. albida (Jeffreys)	White.
26	Velletia lacustris var. compressa (Jeffreys)	Broader and flatter.
—	— — var. moquiniana (Bourg.)	Elevated, compressed at sides.
—	— — var. albida (Jeffreys)	White.
27	Neritina fluviatilis var. cerina (Colb.)	Lemon-coloured.
—	— — var. trifasciata (Colb.)	With three spiral dark bands.
—	— — var. undulata (Colb.)	Transversely banded.
—	— — var. nigrescens (Colb.)	Uniformly dark coloured.

PLATE II. *(continued).*

29	Paludestrina ventrosa var. ovata (Jeffreys)	Spire shorter, whorls four, more tumid.
—	— — var. elongata (Jeffreys)	Spire longer.
—	— — var. pellucida (Jeffreys)	White, transparent.
31	— jenkinsi var. carinata (Smith)	Keeled.
32	— stagnalis var. tumida (Marshall)	More tumid.
—	— — var. barleei (Jeffreys)	Smaller, spindle-shaped, mouth smaller.
—	— — var. octona (Linn)	Smaller, thinner, suture deeper.
—	— — var. albida (Jeffreys)	Whitish.
33	Valvata cristata var. alba (Rowe)	White.
34	— piscinalis var. depressa (C. Pfr.)	Flatter, umbilicus larger.
—	— — var. antiqua (Sowerby)	Spire more raised.
—	— — var. acuminata (Jeffreys)	Spire more produced, apex sharper.
—	— — var. pusilla (Muller)	Smaller, striæ stronger, whorls 4½.
—	— — m. sinistrorsum (Jeffreys)	Sinistral.
35	Bythinia tentaculata var. producta (Menke)	Larger, spire produced.
—	— — var. ventricosa (Menke)	Shorter, more tumid.
—	— — var. excavata (Jeffreys)	Suture deeper, whorls more rounded.
—	— — var. albida (Rimmer)	White.
36	— leachii var. elongata (Jeffreys)	Spire produced.
—	— — var. albida (Rimmer).	White.
37	Vivipara vivipara v. efasciata (Pickering)	Without bands.
—	— — var. atro-purpurea (Lloyd)	Dark purple all over.
—	— — var. albida (Nels. & Tayl.)	White.
—	— — m. sinistrorsum	Sinistral.
38	— contecta var. virescens (Jeffreys)	Without bands.
39	Succinea putris var. subglobosa (Jeffreys)	Shorter, broader, more solid.
—	— — var. stagnalis (Gassies)	Smaller, straighter front margin.
—	— — var. solidula (Jeffreys)	Thicker and deeper coloured.
—	— — var. vitrea (Moq.)	Thinner and paler.
—	— — var. albida (Morch)	White.
40	— oblonga var. alba (Wright)	White.
—	— — m. sinistrorsum (Taylor)	Sinistral.
41	— elegans var. longiscata (Morel)	Shell longer, mouth compressed.
—	— — var. pfeifferi (Rossm.)	Shorter, not so much drawn out.
—	— — var. virescens (Morel)	Thin, greenish yellow.
—	— — var. ochracea (Betta)	Smaller, thicker, spire longer, mouth small.
—	— — var. albida (Taylor)	White.
—	— — m. sinistrorsum (Baudon)	Sinistral.

PLATE I.—(UNIVALVES).

Fig.	*Species & Authority*	*Colouring.*	*Chief Characteristics*	*Habitat*	*Frequency*
1	Segmentina nitida (Müller)	Reddish horn colour	Nautilus-like, internal septa visible outside	Ditches and slow streams	Local
2	Planorbis fontanus (Lightfoot)	Pale horn colour	Flatness, thinness, sharp keel	Ditches and ponds	Frequent
3	— nautileus (Linné)	Greyish white ...	Small size, nautilus-shape, ridges	Ditto	Frequent
4	— dilatatus (Gould)	Horn colour ...	Expanded mouth (introduced)	Canals in Lancashire	Rare
5	— parvus (Say) ..	Greyish horn color	Smoothness, glossiness, absence of keel	Marshes, ditches, and ponds	Local
6	— spirorbis (Müll.).	Dark horn colour	Faint keel, roundish mouth	Ditches, streams, etc.	Common
7	— albus (Müller)	White	Spiral striations	Ditches, canals, and ponds	Common
8	— contortus (Linné)	Dull brown, opaque	Solidity, compactness, crescent-shaped mouth	Ditches and ponds	Frequent
9	— vortex (Linné)	Pale horn colour	Sharp keel, oval mouth	Ditches, streams, etc.	Common
10	— umbilicatus (Müller)	Brown, nearly opaque	Solidity, blunt keel at base of whorl	Ditto	Common
11	— corneus (Linné)	Dark horn colour	Large size; young shells hispid	Ditches, canals, etc.	Common
12	— carinatus (Müller).	Yellowish horn colour	Thinness, sharp keel in centre of whorl	Ditches, streams, etc.	Local
13	Limnæa peregra (Müller)	Variable	Variation in shape and size	Everywhere	Abundant
a	— var. burnetti	Yellowish horn colour	Extremely short spire	Loch Skene, Dumfriesshire	Rare
b	— var. acuminata	Variable ...	Produced spire	Ditches, ponds, etc.	Frequent
c	— var. lutea ...	Yellowish horn colour	Solidity, short spire	Near sea-coast	Local
d	— var. lacustris ...	Ditto	Transverse grooves, glossiness, short spire	Lakes in the north	Frequent
e	— var. obtusa ...	Ditto	Large size, expanded mouth	Ditches, ponds, etc.	Local
f	— var. oblonga ...	Ditto	Oblong shape, compressed in front	Ditches, streams, etc.	Local
g	— var. ovata ...	Variable ...	Thinness, convex whorls, oblong mouth	Ditches, ponds, etc.	Frequent
14	Limnæa palustris (Müller)	Dull brown or purplish	Tapering spire, smallish mouth	Ditches, marshes, ponds, etc.	Common
15	— auricularia (Linné)	Yellowish horn colour	Very expanded mouth, short and sharp pointed spire	Lakes, canals, and rivers	Frequent
16	— stagnalis (Linné)	Greyish horn color	Large size, tapering spire	Canals, ponds, rivers, etc.	Common

VARIETIES AND MONSTROSITIES.

PLATE I.

FIG.		
1	Segmentina nitida var. albina (Taylor)	White.
2	Planorbis fontanus var. albida (Nelson)	White.
3	— nautileus var. lævigata (Adami)	Without ridges.
5	— parvus var. compressa (Lloyd)	More concave below, whorls rounder.
6	— spirorbis var. albida (Jeffreys)	Whitish.
—	— — ecarinata (Jeffreys)	No keel.
—	— — albida (Nelson)	White.
—	— — m. scalariforme (N. & T.)	Whorls disunited.
7	— albus var. draparnaldi (Shepp.)	Carinated, without spiral striæ.
—	— — var. sulcata (Taylor)	With strong curved cross ridges and furrows.
—	— — m. scalariforme	Whorls twisted or disunited.
9	— vortex var. compressa (Mich.)	Thinner, flatter, more sharply keeled.
10	— umbilicatus var. rhombea (Turton)	Smaller, more solid, more concave below.
—	— — var. albina (Jeffreys)	White.
—	— — m. sinistrorsum (Taylor)	Sinistral.
11	— corneus var. albina (Moq.)	White.
12	— carinatus var. disciformis (Jeffreys)	Flatter and thinner.
—	— — var. albida (Hudson)	White.
13 *a*	Limnæa peregra var. burnetti (Alder)	Globose, rather solid, spire scarcely elevated, apex intorted. (Figured).
—	— — — m. scalariforme (Jeffreys)	Whorls disjointed.
—	— — — m. sinistrorsum (Jeffreys)	Sinistral.
—	— — — m. decollatum (Jeffreys).	Spire truncate.
b	— — — var. acuminata (Jeffreys)	Produced spire, smallish mouth. (Figured).
—	— — — var. intermedia (Ferussac)	Thin, compressed towards front margin, spire produced, mouth expanded.
c	— — — var. lutea (Montagu)	Very solid, short spire. (Figured).
—	— — — var. diaphana (Parreyss)	Very thin and transparent.
—	— — — var. picta (Jeffreys)	Shell spirally banded brown and white
—	— — — var. candida (Porro)	White.
—	— — — var. lineata (Bean)	Shell having strong spiral ridges.
—	— — — var. labiosa (Jeffreys)	Outer lip expanded and reflected.
d	— — — var. lacustris (Leach)	Shell small, glossy, with transverse grooves. (Figured).
—	— — — var. inflata (Kobelt)	Shell large, spire small, whorls not very convex, mouth pear shaped.
—	— — — var. patula (Da Costa)	Shell large, spire short, whorls very convex, mouth ample.
e	— — — var. obtusa (Kobelt)	Shell large, spire small, mouth ample. (Figd.).
f	— — — var. oblonga (Jeffreys)	Oblong, compressed in front. (Figured).
—	— — — var. boissyi (Dupuy)	Small, globose, whorls convex, spire produced.
—	— — — var. vulgaris (Pfeiffer)	Small, spire not very prominent, whorls and aperture less convex than type.
—	— — — var. pulchella (Roffiæn)	Small, lines of growth pronounced, slight margin to aperture.
—	— — — var. succineæformis (Jeff.)	Very thin, shaped like a *Succinea*.
—	— — — var. maritima (Jeffreys)	Dwarfed, solid, spire produced, suture deep.
—	— — — var. microstoma (Kobelt)	Long and slender spire, like *L. palustris*.
g	— — — var. ovata (Draparnaud)	Shell large, rather thin, spire short, mouth oblong. (Figured).
—	— — — v. stagnaliformis (Taylor)	Somewhat fusiform or spindle shaped.

PLATE II.

Fig. 17.

Fig. 18.

Fig. 19.

Fig. 20.

Fig. 21.

Fig. 22.

Fig. 23.

Fig. 24.

Fig. 25.

Fig. 26.

Fig. 27.

Fig. 28.

Fig. 29.

Fig. 30.

Fig. 31.

Fig. 32.

Fig. 33.

Fig. 34.

Fig. 35.

Fig. 36.

Fig. 37.

Fig. 39.

Fig. 40.

Fig. 38.

Fig. 41.

PLATE III.

Fig. 42.

Fig. 43.

Fig. 44.

Fig. 47.

Fig. 45.

Fig. 46.

Fig. 49.

Fig. 48.

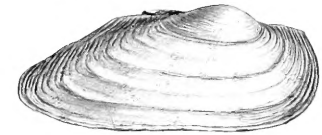


Fig. 51.

Fig. 50.

Fig. 52.

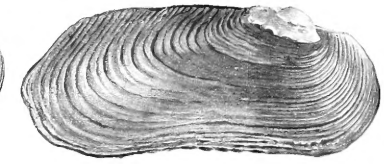


Fig. 53.

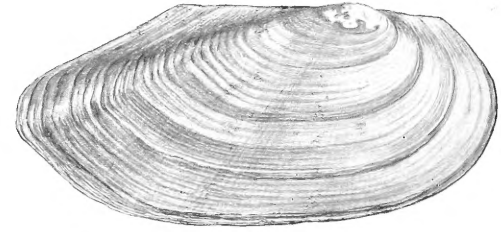


Fig. 54.

Fig. 55.

Fig. 56.